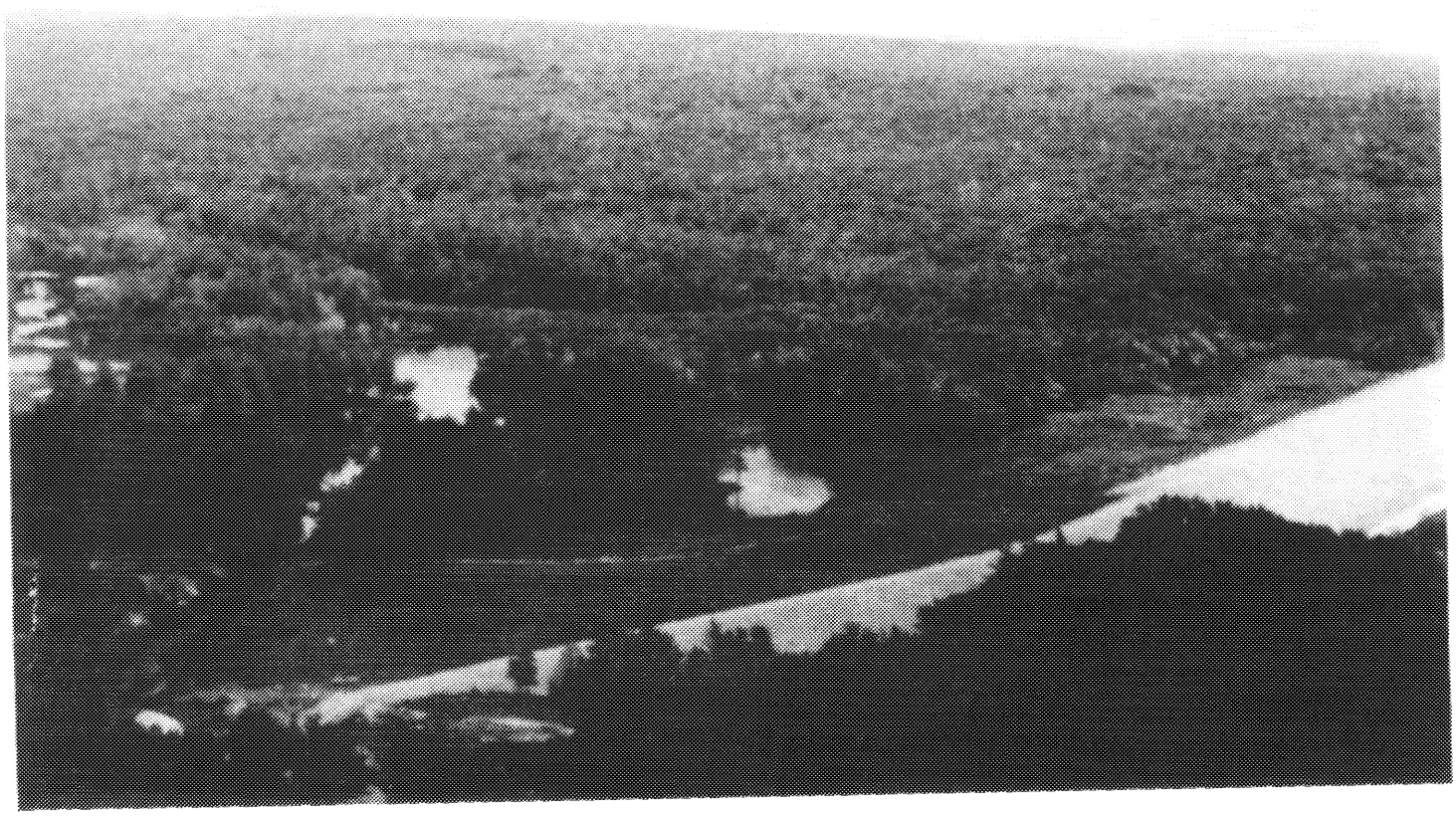
Drought Contingency Plan

US Army Corps
of Engineers
New England Division

SEPTEMBER 1993

West Hill Dam, Uxbridge, Massachusetts



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In the 1990's New England Division started updating drought contingency plans that were previously developed in the 1980's.

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13. ABSTRACT (Maximum 200 words)

This drought contingency plan includes a description of existing water supply conditions, the possibility of reallocation of reservoir storage within specified limits, evaluation of water quality, discussion of impacts on other project purposes, and the effects on the environment.

Due to a variety of reasons, mainly topography and distance from potential beneficiaries, the Commonwealth of Massachusetts Executive Office of Environmental Affairs are not interested in sponsoring emergency storage at the project. Therefore, drought contingency storage for emergency water supply purposes at West Hill Dam is not implementable.

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SUMMARY

In the 1990's NED started updating drought contingency plans that were previously developed in the 1980's for some of our reservoirs. One of the requirements to updating the drought contingency plans, to make them fully implementable, is state sponsorship. If there is no state sponsorship then a nonfeasible plan will be published for that particular project.

In letter, dated August 11, 1992 (copy attached), the Commonwealth of Massachusetts Executive Office of Environmental Affairs, Department of Environmental Protection (DEP) withdrew its support as a sponsor for the drought contingency plan at West Hill Dam. The DEP indicated for a variety of reasons, mainly topography and distance from potential beneficiaries, they currently are not interested in sponsoring emergency storage at the project. Therefore, the Massachusetts DEP is not interested in entering into a contract with the Corps.

Since there is no state sponsorship for drought storage at West Hill Dam, the drought contingency plan previously developed is presented herein for informational purposes only. If, at some future date, the state were to indicate an interest, drought contingency storage will be re-evaluated and this report updated as necessary to respond to the state request.

DROUGHT CONTINGENCY STORAGE FOR EMERGENCY WATER SUPPLY PURPOSES AT WEST HILL DAM IS NOT IMPLEMENTABLE

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Daniel S. Greenbaum
Commissioner

August 11, 1992

Mr. Richard D. Reardon
Director of Engineering
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Mr. Reardon:

I am responding to your letter of June 2, 1992 regarding the Commonwealth's interest in the development of drought storage capacity at several Corps dams. After having reviewed the water supply situation in the communities proximate to the reservoirs, the Department has not identified a user for the water for the purposes described in your letter. Based on this determination, the Department will not enter into a contract with the Corps at this time.

I thank you for the offer of assistance and look forward to working with your office on projects of mutual interest in the future.

Sincerely,

Arleen O'Donnell
Assistant Commissioner

cc: Charles Joyce

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

June 2, 1992

Engineering - Water Control

Ms. Arleen O'Donnell
Assistant Commissioner, Resource Protection
Department of Environmental Protection
One Winter Street
Boston, Massachusetts 02108

Dear Ms. O'Donnell:

The New England Division, Corps of Engineers, is currently updating previously developed plans for drought contingency storage at some of our reservoirs in Massachusetts. We have identified these projects as having merit in providing a source of water supply during drought emergency conditions. Each reservoir has been initially screened by this office and an appropriate plan developed. Listed below are names and locations of each candidate reservoir in Massachusetts. Attachments 1 through 7 present fact sheets with pertinent information for each project, and attachments 8 through 10 show locations. In addition, the study for Tully Lake in Royalston, Massachusetts, is nearing completion, and is in the process of being finalized with the Department of Environmental Protection. Our mutual efforts were unable to identify a community or State agency that would be interested in emergency storage at Tully Lake; therefore, the Department of Environmental Protection is not interested in entering into a contract with the Corps.

Name	Location
East Brimfield Lake*	Sturbridge
Westville Lake	Sturbridge
West Hill Dam	Uxbridge
Littleville Dam	Huntington
Knightville Dam	Huntington
Hodges Village Dam	Oxford
Buffumville Dam	Charlton

* Currently scheduled for study in fiscal year 1993

The Drought Contingency Plan (DCP) presents a basic planning aid assessment of Corps projects as a potential emergency short term water supply source during a State-declared drought emergency, with each DCP identifying the following:

a. Hydrologic assessment of drought storage potential.

b. Standard operating procedure for drought storage and releases.

c. State sponsor for the plan and potential beneficiary.

d. Draft Drought Emergency Water Contract identifying conditions of the emergency water storage, withdrawal, and cost.

Previously, we were requesting interest by the Commonwealth of Massachusetts on a project-by-project basis. In an effort to reassess and update the entire drought contingency program, we are requesting your agency forward a letter to this office expressing interest in participation in the program for all candidate reservoirs within the Commonwealth. You are, therefore, requested to review the attached list of projects, solicit the surrounding towns for interest, determine your interest in all or some of them and provide us with a prioritized list. Your letter should identify the appropriate State agency to act as sponsor for the DCP and signatory to the contract, potential water supply user, and method of transporting water (i.e., reservoir releases, trucking, etc.) for each project. When determining a user, surface water treatment facilities should be available. If treatment facilities are not available within a specific region, you should carefully consider if sponsoring a particular project is feasible. The Commonwealth would incur no costs for the preparation of the DCP or for the water itself until such time as the Governor declared a drought emergency in the area in question and a decision made to begin emergency storage at the particular dam.

If you have any questions regarding this request or would like to set up a meeting to discuss the possibilities of

drought contingency storage, please contact Mr. Steven Simmer of my staff at 617-647-8524.

Sincerely,

Richard D. Reardon
Director of Engineering

Attachments

CF:
Mr. Simmer - 115N
Mr. Joyce - 114S
Reading File
Engr Dir Files - 112S

BLACKSTONE RIVER BASIN
WEST RIVER WATERSHED

DROUGHT CONTINGENCY STORAGE PLAN
WEST HILL DAM

SEPTEMBER 1986

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

SYLLABUS

This report is a compilation of basic information on the Corps of Engineers West Hill Dam and reservoir to aid the assessment of the project as an emergency domestic water supply source. Included are sections on project description, operating procedure, available storage capacity, water quality, public water supply systems in the region and potential impacts. It was not within the scope of the study to perform detailed analyses but mainly to address the emergency potential of the site and identify and discuss a variety of concerns to be considered in weighing West Hill versus any other available sources of emergency supply. A review for compliance with all current applicable environmental, riparian or other laws would be required at the time of any decision to pursue drought contingency storage at the project. The Corps of Engineers would not consider drought storage activities at West Hill without an official request from the State of Massachusetts.

At a pool elevation of 245 feet NGVD (11-foot stage), the West Hill flood control dam and reservoir could provide about 1,400 acre-feet (460 MG) of emergency water supply storage, equivalent to a yield of 5 MGD for 3 months. However, storage above elevation 240 feet NGVD, storage capacity 410 acre-feet (143 MG), would close down, by inundation, a recreation area in the upstream reservoir, and would not be recommended except under emergency conditions. Emergency storage could also result in some degradation of water quality, and stored waters would require complete treatment for domestic use. Emergency storage would impact vegetation at the lower levels of the reservoir and could increase warm water fisheries with a decline in the cold water fisheries. Other potential environmental impacts are discussed in the report.

The West Hill project is located in south-central Massachusetts where public water supplies service a population of over 300,000 people.

DROUGHT CONTINGENCY STORAGE PLAN
WEST HILL DAM

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WEST HILL DAM

1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency storage plan of operation for West Hill Dam that would be responsive to public needs during drought periods and identify possible modifications to project regulation within current administrative and legislative constraints. This plan was based on preliminary studies utilizing readily available information. Included are a description of existing water supply conditions, the potential for allocation of reservoir storage within specified limits, an evaluation of water quality, a discussion of impacts on other project purposes, the effects on the environment, and a summary and conclusions.

2. AUTHORIZATION

The authority for the preparation of drought contingency plans is contained in ER 1110-2-1941, which provides that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basin-wide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

West Hill Dam and Reservoir was authorized by the Flood Control Act of 22 December 1944, in accordance with House Document No. 624, 78th Congress. Construction of the project was initiated in June 1959 and completed in 1961.

4. PROJECT DESCRIPTION

West Hill Dam is primarily a single purpose flood control project located in south-central Massachusetts on the West River, Blackstone River Basin. A map of the Blackstone River Basin is shown on plate 1. Though there is no impoundment, by the dam, of water for recreation, there is a recreation area managed by the Corps at a natural "swimming hole" on the West River in the upstream reservoir area.

The reservoir has a total storage capacity of 12,440 acre-feet when filled to spillway crest, which is equivalent to 8.3 inches of runoff from the project's 27.9 square mile drainage area. When filled to spillway crest (El. 264 FT NGVD), a 1,025 acre pool would be created. A capacity table is shown on plate 2.

The physical components of West Hill Dam consist of a 2,400 foot long earthfill dam, a 50-foot long concrete spillway, outlet works, and four earth dikes. The outlet works, located in the concrete spillway section, consist of 3 gated conduits through the spillway, each 3 feet wide by 5 feet high with inverts at elevation 234.

A summary of pertinent data at West Hill Dam is listed on plate 3.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. The three gates at West Hill Dam are normally maintained at a 0′-3′-0′ setting.

b. Flood Periods. West Hill Dam is operated to provide flood protection to downstream communities on the West River and further downstream on the Blackstone River. Regulation may be considered in three phases during the course of a flood: Phase I - the appraisal of storm and river conditions during the development of a flood leading to initial regulation, Phase II - regulation of the project while the West and/or Blackstone River floodflows crest and move downstream, and Phase III - emptying the reservoir following the downstream recession of the flood. The Standard Operating Procedure (SOP) for regulating the reservoir is detailed in the Master Water Control Manual for the Blackstone River Basin.

c. Regulating Constraints

(1) Minimum Releases. A minimum release of approximately 10 cfs is maintained during periods of flood regulation in order to sustain downstream fish life. During nonflood periods, the minimum outflow generally equals minimum inflow.

(2) Maximum Releases. The maximum nondamaging discharge immediately downstream of West Hill Dam is about 425 cfs.

6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 31 New England Division flood control dams and continually monitors rainfall, snow cover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corps Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with the respective Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. The area of concern is the south-central portion of Massachusetts, including portions of Worcester, Middlesex, and Norfolk counties. Table 1 contains information about public water suppliers in the area based on information provided by the Massachusetts Department of Environmental Management, Division of Water Resources. Of the 19 communities in the study area, all but one are at least partially served by a public water supply system. The one community without a public water supply system is Millville. No data is available for this community or the portions of other communities dependent on private individual supplies.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of West Hill Dam that could benefit from storage at the project, and to present the data in a manner portraying existing water supply conditions. Projections of future demands were not developed because this study addresses only modifications in the operational procedures at West Hill Dam in order to provide storage for water supply purposes when drought conditions exist, and not to meet normal water supply demands at some future date.

c. South-central Massachusetts Water Suppliers. As noted in Table 1, the data given for each water supplier includes: community served, estimated population served by the system, source of supply (ground or surface water), average day and maximum day demands for 1984, estimated safe yield of the source, and any further information available on the source of supply. An analysis of the adequacy of existing sources during drought conditions has not been performed. The information has been accumulated to present a summary of the existing water supply conditions for the south-central Massachusetts area.

d. Population Projections. Population projections for communities in the study area are given in table 2 to show population trends for each community potentially affected by a prolonged dry period. The population projections were provided by the Department of Environmental Management, but were developed by regional planning agencies encompassing communities in the vicintiy of West Hill Dam. This information indicates areas of potential future growth in the south-central Massachusetts area.

8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local

TABLE 1
MAJOR WATER SUPPLIERS - SOUTH CENTRAL MASSACHUSETTS

Company or Agency	Town Served	Est. Population Served - 1980	Source of Supply (SW/GW)	1984 Demands Avg. Day (MGD)	1984 Demands Max. Day (MGD)	Safe Yield (MGD)	Comments
Bellingham Water Dept.	Bellingham	13,961	GW	1.15	1.84	2.25	7 Wells
Blackstone Water Dept.	Blackstone	6,158	GW	0.45	0.93	0.78	2 Wells 1 Well (Standby)
Douglas Water Dept.	Douglas	2,611	GW	0.19	0.32	0.50	1 Wellfield 1 Well
Mass. American Water Co.	Grafton	5,332	GW	0.56	1.02	2.14	4 Wells
So. Grafton Water District		2,810	GW	0.19	0.24	0.55	2 Wells (One unreliable during summer)
Holliston Water Dept.	Holliston	11,360	GW	0.97	1.63	2.57	6 Wells
Hopedale Water Dept.	Hopedale	2,226	GW	0.51	0.54	0.52	Wellfield Milford Water Co (SW/GW)
Hopkinton Water Dept.	Hopkinton	5,700	GW	0.59	1.24	1.11	3 Wells
Medway Water Dept.	Medway	8,109	GW	0.72	1.35	1.40	3 Wells
Milford Water Co.	Mendon	450	SW/GW				Included in Milford System
Milford Water Co.	Milford	25,039	SW/GW	2.80	4.24	3.00	Echo Lake - 1.40 MGD Wellfield - 1.60 MGD
Mass. American Water Co.	Millbury	5,366	GW	1.05	1.49	3.11	4 Wells
Maple Hillside Water Dist.		311		0.02	0.03		Mass. American Water Co.
Oakwood Heights Water Dist.		200		0.01	0.01		Mass. American Water Co.
	Millville						No Central Water Supply
Whitinsville Water Co.	Northbridge	10,340	GW	1.07	1.42	2.55	3 Wellfields
Shrewsbury Water Dept.	Shrewsbury	20,407	GW	2.70	4.44	4.18	7 Wells Connected to Worcester System
Manchaug Water Dist.	Sutton	850	GW	0.03	0.05	0.05	3 Wells
Wilkinsonville Water Dist		400	GW	0.12	0.20	0.28	1 Well
Upton Water Dept.	Upton	2,215	GW	0.26	1.11	0.69	1 Wellfield 1 Well
Uxbridge Water Dept.	Uxbridge	4,362	GW	0.54	0.72	2.49	3 Wells
Westborough Water Dept.	Westborough	13,346	SW/GW	2.14	3.50	2.02	Sondra Pond - 0.75 MGD 4 Wells - 1.27 MGD
Worcester Department of Public Works	Worcester	161,799	SW/GW	25.24	34.15	29.00	Reservoir System - 26.80 MGD 2 Wells - 2.20 MGD

TABLE 2
POPULATION PROJECTIONS - SOUTH CENTRAL MASSACHUSETTS

Town	Actual 1980	1985	1990	1995	2000	Percent Change 1980-2000
Bellingham	14,300	15,600	16,900	17,200	17,500	22.4
Blackstone	6,570	6,725	6,825	6,925	7,025	6.9
Douglas	3,730	3,850	3,925	4,100	4,200	12.6
Grafton	11,238	11,450	11,750	11,975	12,175	8.3
Holliston	12,622	13,500	14,400	14,600	14,700	16.5
Hopedale	3,905	4,000	4,125	4,150	4,200	7.6
Hopkinton	7,114	8,300	9,400	9,700	10,000	40.6
Medway	8,447	9,200	10,000	10,200	10,400	23.1
Mendon	3,108	3,350	3,450	3,625	3,725	19.9
Milford	23,390	24,700	26,000	26,300	26,600	13.7
Millbury	11,808	12,175	12,450	12,725	12,925	9.5
Millville	1,693	1,750	1,800	1,825	1,875	10.8
Northbridge	12,246	12,450	12,650	12,950	13,225	8.0
Shrewsbury	22,674	23,650	24,225	24,925	25,400	12.0
Sutton	5,855	6,350	6,725	6,950	7,225	23.4
Upton	3,886	4,125	4,225	4,425	4,525	16.4
Uxbridge	8,374	8,575	8,675	8,750	8,850	5.7
Westborough	13,619	14,275	14,825	15,625	16,050	17.9
Worcester	161,799	161,800	161,800	161,800	161,800	0.0
TOTAL	336,378	345,825	354,150	358,750	362,400	7.7

communities in need. In addition, guidance contained in ER 1110-2-1941 directs field offices to determine the short-term water supply capability of existing Corps reservoirs that would be functional under existing authorities. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purposes.

b. Drought Contingency Storage. It has been determined that a portion of the existing storage at West Hill Dam could be utilized for emergency drought contingency storage without having an impact on the project's flood control function, though any storage above elevation 240 feet NGVD (410 Acre-Feet) will close down, by inundation, a recreation area in the upstream reservoir area. Filling above 240 feet NGVD would, therefore, not be recommended except under emergency conditions. Emergency storage could be made available to a pool elevation of approximately 245 feet NGVD (11-foot stage). This represents a volume of about 1,430 acre-feet, equivalent to 465 MG or approximately 8 percent of the total reservoir storage. This 1,430 acre-feet represents an infringement on flood control storage of about 0.96 inches of runoff.

Based on an all season low flow duration analysis using 22 years of flow records for the West River gaging station immediately downstream of West Hill Dam (DA = 27.9 square miles), it was determined that, during a 10-year frequency drought, the volume of runoff could fill the reservoir from elevation 234 to 245 feet NGVD in a 101-day low flow period provided no releases were made from the dam. With a release of 2.8 cfs (0.1 cfs/square miles) from the dam during a 10-year frequency drought, filling of the reservoir to elevation 245 feet NGVD would take longer than 1/2 year. Using the 10-year frequency, 7-day low flow value of 1.7 cfs as a minimum release from West Hill Dam during a drought emergency, the reservoir could be filled to elevation 245 feet NGVD in 1/2 year. It is evident that West Hill Dam could not be filled to its drought contingency storage pool in a reasonable time frame during a 10-year frequency summer-fall drought period with releases being made from the dam. However, if there were enough forewarning to fill the reservoir during a May-June time frame, during a 10-year frequency drought with 2.8 cfs being released from West Hill Dam, it would take 40 days to fill the pool from elevation 234 to 245 feet NGVD.

The stored water could be used for municipal supply with proper treatment, either by drawing directly from the reservoir or releasing the waters for downstream withdrawal. Drought Contingency Storage vs. Flow Duration Curves at West Hill Dam are shown graphically on plate 4.

c. Effect of Regulated Flows. The curtailment of flows from West Hill Dam during the drought emergency could adversely impact on the flowage rights of downstream riparian users. At this time, however, it is not possible to review all of the various drought emergency situations that could occur, nor is it within the scope of this report to identify all those with water rights. It is important to note that when a specific drought emergency does occur, the legal implications would have to be weighed.

9. WATER QUALITY EVALUATION

a. Water Quality Classification. The Massachusetts Water Resources Commission designates the West River as class B from its source to its confluence with the Blackstone River. Class B waters are managed for the protection and propagation of fish, other aquatic life and wildlife, and for primary and secondary contact recreation. The West River is further designated as a cold water fishery.

Technical objectives for class B cold water fisheries include pH within 6.5 to 8.0 standard units, a minimum dissolved oxygen of 6 mg/l and a maximum temperature of 68 degrees F. Fecal coliform bacteria should not exceed a log mean of 200 per 100 ml for a set of samples nor should more than 10 percent of the total samples exceed 400 per 100 ml during any monthly sampling period. Nutrients should not exceed the site-specific limits necessary to control accelerated or cultural eutrophication. In addition, the waters shall be free from pollutants in concentrations or combinations that produce objectionable color or turbidity, exceed recommended limits on the most sensitive receiving water use, or injure or are toxic to humans or aquatic life. Naturally occurring conditions which cause these criteria to be exceeded are not considered violations of state water quality standards.

b. Existing Water Quality. The West River's water quality at West Hill Dam usually meets or exceeds Massachusetts class B requirements. Occasionally, however, some objectionable levels have been observed for several water quality parameters, including dissolved oxygen, pH, fecal coliforms, heavy metals and color. Nutrient levels in the West River are high enough to sustain nuisance algal blooms but algal development is prevented by the absence of a permanent pool. Since NED began monitoring water quality at inflow, beach and discharge stations in 1971, no significant changes have been observed.

Currently there are a few point and nonpoint pollution sources upstream of the dam which may influence water quality at the project. These include the Upton Wastewater Treatment Plant (WWTP), a small untreated discharge from the Miscoe Brook Bottling Company, and a landfill operation adjacent to

the river in Upton. These are suspected of contributing to the intermittent high BOD and coliform bacteria levels recorded at the project, particularly during low flow periods. The Upton landfill may also be the source of rare elevated cadmium measurements.

Also, considerable swampy areas in the headwaters and marshes within the project area are natural conditions causing consistently high color levels and occasionally low pH measurements.

c. Water Quality Requirements for Drought Storage. There are two requirements to be met. The waters must satisfy state standards for surface waters and must be of a quality appropriate for the water supply users. Standard treatment of water designated class B in Massachusetts is usually sufficient to develop municipal water supply. Industrial processes dictate the industrial water quality needed. Drought contingency storage would always be suitable for firefighting and irrigation.

d. Effects of Drought Storage. Water stored at West Hill Dam for drought relief will be adequate for municipal water supply after treatment. However, the act of storing water at West Hill Dam may cause some degradation of water quality at the project which may adversely affect its use for recreation and aquatic habitat, and may severely affect the downstream aquatic life due to a reduction in streamflow. Anticipated increases in algal growth due to increased hydraulic residence time may diminish the fish population at the site. Drought storage may affect an increase in fecal coliform counts which could restrict bathing. Releases in the range of 0 to 10 cfs to build up and maintain the drought pool may severely impact on downstream aquatic life. Water quality parameters, especially dissolved oxygen and fecal coliform, should be monitored as long as the drought pool is established.

Water quality conditions during drought storage will differ from existing water quality in two ways. First, creation of a semi-permanent pool will flood additional land and increase the hydraulic residence time on the project. Secondly, influent water quality conditions will likely be degraded during the low flow condition that will occur during a drought.

By establishing a drought pool at West Hill Lake, 245 acres of land would be flooded. The decay of organic material on this land may cause increases in levels of color and soluble nutrients. The death of vegetation in the newly inundated areas would also loosen the soil and cause acceler-rated erosion in these areas when the pool is lowered. Most of the eroded soil would settle in the lake, but some would be discharged downstream. This increased erosion and

sedimentation will not affect the suitability of the water for water supply or recreation, but will slightly diminish the aesthetics of the area.

Critical water quality conditions are usually associated with low flow periods. Current hydrologic conditions and reservoir regulation practices promote generally good water quality. However, drought water character will be affected by the consequences of reduced precipitation, surface runoff, inflows and discharges. Over an extended time of low flows, some deterioration in water quality can be expected in the influent water courses, the reservoir and the discharge.

e. Summary. West Hill Dam's basically good water quality may be somewhat diminished when drought storage is formed; however, it will be adequate, with standard treatment processes, to provide municipal water supply. Downstream aquatic life may be negatively impacted during drought pool buildup and maintenance due to a reduction in streamflow. Under the reduced flushing condition which would occur during storage, coliform counts may increase to the point that bathing should be restricted. During drought storage a monitoring program should be set up to include dissolved oxygen, heavy metals and bacteria levels.

Intermittent coliform bacteria, dissolved oxygen, color, metals and pH violations have been observed in the past. During a drought event, these violations may occur more frequently. Algal blooms are likely. Establishing a drought pool would also elevate levels of turbidity, erosion and sedimentation to some degree. Nonetheless, the water should be suitable for water supply after treatment. Firefighting, irrigation and some industrial needs will be met without treatment.

10. DISCUSSION OF IMPACTS

a. General. Any action resulting in a temporary change of a reservoir's storage volume may have impacts on other project purposes which must be evaluated before a storage reallocation plan can be implemented. An evaluation has been made of the impacts resulting from drought contingency storage on the flood control purpose of this project. Effects on recreation, sedimentation and the aquatic and terrestrial environments as well as the historic and archaeological resources are also discussed in the following paragraphs. Because of the minimal level of effort afforded this study, certain environmental concerns may require further consideration prior to project implementation.

b. Flood Control. A review of the regulation procedures at West Hill Dam was undertaken to determine the volume of water that could be made available for drought contingency purposes. The water would be stored by temporarily utilizing

existing flood control storage. It is recognized that major floods occur in every season of the year, thus any use of flood control storage would be continually monitored to insure that there would be no adverse impacts on downstream flood protection.

At West Hill Dam the maximum pool level for drought contingency storage would be at elevation 245 feet NGVD. This increase represents an infringement on the flood control storage of about 0.96 inches of runoff or 8 percent of the total flood storage volume. However, any storage above elevation 240 feet NGVD would close down, by inundation, a recreation area and would, therefore, not be recommended except under emergency conditions.

c. Project Operations. West Hill Dam does not impound a recreation pool. The recreation area is at a natural subimpoundment. All the vegetation between the natural pool and an emergency drought contingency pool would likely die from prolonged flooding. No weir exists to control the depth of a drought storage pool, therefore the pool level would have to be maintained by gate operations. Any additional operation and maintenance costs as well as possible cleanup costs for damaged vegetation would be borne by the user.

d. Effects on the Aquatic Ecosystem. The aquatic resources of the West Hill Dam Project area consist of the West River, including Harrington's Pool and the tributaries to West River, Miscoe Brook, Mill Brook, and a third unnamed brook which flows southeasterly into the West River along West Hill Road. The West River is a slow-moving stream classified Riverine/Lower Perennial/Unconsolidated Bottom according to the U.S. Fish and Wildlife Service classification system.

The aquatic habitats support both cold water and warm water fisheries. There has been no official sampling of the fish populations of the West River; however, the Massachusetts Division of Fisheries and Wildlife stocks trout each spring for a put and take fishery. The hatchery trout stocked in recent years have included approximately 500 eastern brook trout (Salvelinus fontinalis), 1,200 brown trout (Salmo trutta), and 4,000 rainbow trout (Salmo gairdneri). High summer water temperatures preclude the establishment of a significant native trout fishery in the river. Warm water game fish which likely inhabitat the rivers and particularly Harrington's pool included largemouth bass (Micropterus salmoides), smallmouth bass (M. dolomieui), chain pickeral (Esox niger), and bluegills (Lepomis macrochirus). Among the benthic invertebrates of the river is the freshwater mussel (Elliptio sp.). Benthic fauna most likely also includes crustaceans and aquatic insects.

With storage of drought contingency waters to elevation 245 ft., a 245-acre pool would be created, an increase of 141 acres over the 104 acres of natural pondage in the reservoir area. If drought contingency storage were to begin during May-June as required to store sufficient waters, additional spawning and nursery habitat could be created. Largemouth bass, smallmouth bass, and bluegills spawn primarily in May and June; chain pickeral spawn earlier in the spring. The increased spawning area could result in the establishment of an extra large year class of warmwater species and a general increase in productivity and carrying capacity for a short time; however, if the decay of leaf litter adds to the oxygen debt during June-July, dissolved oxygen levels could become a limiting factor. As the drought contingency waters recede through late summer, the extra large population of young of year fish would be concentrated into the progressively smaller flooded area. As predatory fish consume much of this year class they would experience increased growth rates, thus benefitting the fishery.

The spreading of shallow waters over the floodplain would increase the surface to volume ratio with a resulting increase in water temperatures. This, along with reduced hydraulic residence time, which may lead to algal blooms, and decomposition of floodplain organic matter could increase the oxygen demand in the temporary impoundment. Because the cold water fish species whose tolerance for low dissolved oxygen levels and higher temperatures do not last into the summer and because existing conditions with regard to dissolved oxygen deteriorate through the summer, this resource should not be impacted. The conditions could be severe enough to impact the warm water fishery, but since the tolerance of these species is higher and some flushing will continue to occur from upstream reaches, the severity of impacts is questionable. Dissolved oxygen levels would have to fall below 5 milligrams/liter to impact the warm water fishery.

Restriction of downstream flows during the collection and storage of drought contingency waters could result in downstream fishery impacts. Restricted flows would concentrate the existing populations into waters which may, because of the drought conditions, be experiencing low dissolved oxygen levels and higher temperatures and, therefore, lowered carrying capacity. The minimum release of 2.8 cfs, however, will be significantly greater than the ten-year seven-day lowflow volume of 1.7 cfs which is the most severe condition the river would be expected to experience in ten years.

e. Effects on Wetlands and Upland Vegetation. Wetlands of the West River floodplain are generally of two types: forested swamp and shrub swamp. The forested wetlands would be classified Palustrine/Forested/Broad-leaved Deciduous, according to the U.S. Fish and Wildlife Service classification system. These wetlands are dominated by red maple (Acer

rubrum) with isolated white pine (Pinus strobus), and gray birch (Betula populifolia). The understory consists of silky dogwood (Cornus amomum), speckled alder (Alnus rugosa), arrow-wood (Viburnum recognitum), meadow-sweet (Spirea latifolia), cinnamon fern (Osmunda connamomea), sensitive fern (Onoclea sensibilis), tussuck sedge (Carex stricta), and marsh mallow (Hibiscus palustris).

The shrub swamps of the floodplain are classified Paulstrine/Scrub-shrub/Broad-leaved deciduous. These wetlands are dominated by tall shrubs including silky dogwood and black willow which line much of the river channel. Arrow-wood, meadow-sweet, and speckled alder are also present.

The floodplain wetland extends to an abrupt, steeply sloped upland boundary. The dominant upland tree is white pine, although some areas contain a mixture of white pine, Northern red oak (Quercus rubra), and white ash (Fraxinus americana).

The results of flooding in soils are the following: exclusion of oxygen from the roots, carbon dioxide accumulation in the soil, production of toxins (organic acids and gases) by soil anaerobes, and anaerobic conditions around the roots. Low oxygen is the primary limiting factor. These factors combine to cause stress conditions for the plants experiencing flooding. The effects flooding will have on a tree species depend on the species tolerance to flooding and on an individual tree's acclimatization to flooding. Drought tolerance classifications for tree species are provided in "Flood Tolerance in Plants: A State of the Art Review" published by the U.S. Army Engineer Waterways Experiment Station in August 1979. The tree species of the West River floodplain are, with the exception of white pine, relatively tolerant to flooding. Red maple occur in wetlands and are tolerant to flooding (able to survive deep flooding for one growing season, with significant mortality occurring if flooding is repeated the following year). White ash and Northern red oak are classified as slightly tolerant (able to survive flooding or saturated soil for 30 consecutive days during the growing season) and white pine and gray birch are classified as intolerant (unable to survive more than a few days of flooding during the growing season without significant mortality). The white pine of the floodplain would be slightly more tolerant to flooding than the upland white pine because they are acclimated to periodic flooding. The shrub/sapling black willow is considered very tolerant to flooding (able to survive deep prolonged flooding for more than one year). Classification of the other floodplain shrub species is not available; however, the habitat typical of these species is similar to that of the species classified as tolerant. It may be expected that their tolerances would be similar.

Drought storage would likely start at the beginning of the growing season during May-June. During a ten-year frequency drought with a 2.8 cfs release from the dam, it would take 40 days to fill the pool from elevation 234 to 245 feet NGVD. During this 40-day period, progressively more land area would be inundated up to 245 acres. Depending on the amount of time drought contingency waters are stored, the distance from the channel could influence survival of vegetation. The vegetation closest to the channel would be flooded for the greatest amount of time and may experience the greatest impacts. Tolerant and intolerant species may not be destroyed by flooding lasting the entire growing season. Red maple, the dominant floodplain wetland species, is classified tolerant. Slightly tolerant and intolerant species would most likely be destroyed depending on their placement in the floodplain relative to time of flooding.

The herbaceous vegetation of the floodplain and the smaller shrubs would most likely be destroyed with prolonged flooding since they would be completely inundated. Reestablishment of the herbaceous vegetation would most likely occur in the first or second season after the drought year. Because of the steep slopes at the floodplain/upland boundary, very little upland habitat would be impacted. Some "islands" of upland vegetation are present in the floodplain. All of the upland vegetation flooded for more than 30 days would be destroyed. Destruction of vegetation on the upland slopes could lead to soil erosion problems in later years and a change in species composition.

Downstream vegetation, particularly wetland vegetation, would be subjected to low moisture stress because of the drought conditions, compounded by low releases from the dam. This could result in a poor growth year for downstream vegetation.

f. Effects on Wildlife. Furbearing and game mammals of the West Hill Dam area include red fox (Vulpes fulva), raccoon (Procyon lotor), porcupine (Erethizon dorsatum), woodchuck (Marmota monax), snowshoe hare (Lepus americanus), cottontail rabbit (Sylvilagus floridanus), striped skunk (Mephitis mephitis), gray squirrel (Sciurus carolinensis), muskrat (Ondatra zibethicus), and white-tailed deer (Odocoileus virginianus). Upland game birds include woodcock and ruffed grouse. Waterfowl which are known to use the area include mallards, black ducks, wood ducks, and Canada geese. Great blue heron, osprey, red shouldered hawks, and red-winged blackbirds also use the area. Because of the varied structure of the wetlands and surrounding areas and juxtaposition of habitat types, the area most likely supports a diversity of avifauna.

Upland wildlife partially dependent on the wetlands and wetland wildlife could be impacted by the unusual flooding

conditions. There would be a reduction of feeding habitat for such species as red fox, raccoon, and striped skunk with the reduction of terrestrial area. Use of the floodplain area by small mammals such as meadow vole (Microtus pennsylvanicus) is most likely minimal because of the periodic flooding; however, any small mammals which do use the area will be displaced by the flooding.

Semi-aquatic mammals such as muskrat, mink (Mustela vison), and river otter (Lutra canadensis) which establish dens in river banks would probably not be impacted by den flooding since flooding to elevation 245 occurs approximately twice a year under existing conditions. The increase in aquatic habitat could provide temporary additional forage areas for these species.

Ground or shrub nesting birds such as Canada geese, red-winged blackbirds, and swamp sparrows could be impacted if floodwaters inundate their nests.

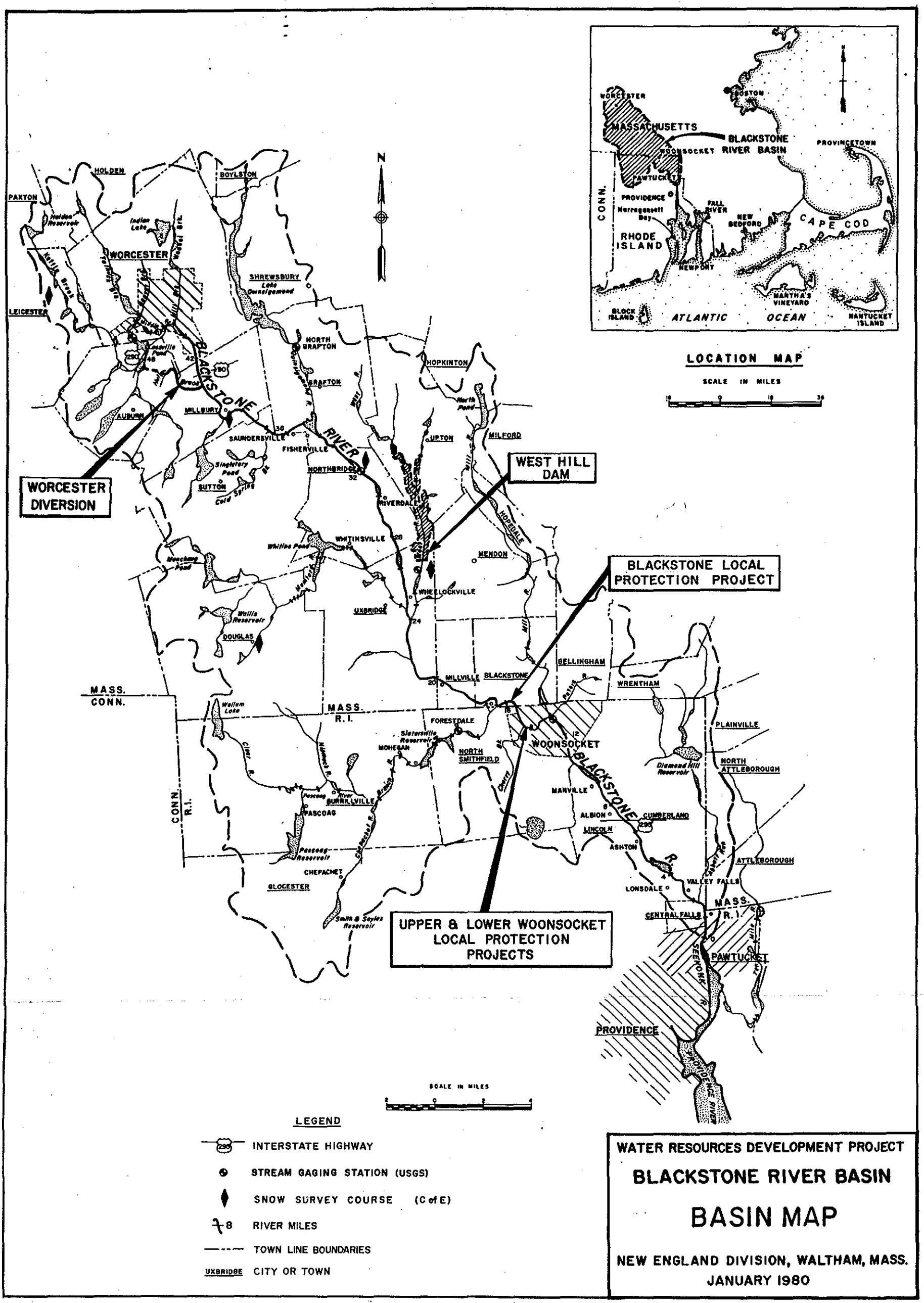
g. Historic and Archaeological Resources. While there are no recorded prehistoric, archaeological, or historic sites within the West Hill Project, unrecorded sites may be present. Under existing conditions the area is flooded to the drought contingency elevation (elevation 245 feet NGVD) or more 1 to 2 times a year. However, the drought contingency storage would be held for a greater length of time. This could accelerate deterioration of sensitive cultural resources.

Prior to implementation of the drought contingency plan, an archaeological survey would be required involving several weeks duration.

11. SUMMARY AND CONCLUSIONS

The West Hill flood control dam and reservoir is located in south-central Massachusetts in a region where existing public water supply systems service over 300,000 people. At a pool elevation of 245 feet NGVD (11-foot stage), the West Hill project could provide about 1,400 acre-feet (460 MG) of emergency water supply storage, equivalent to a yield of 5 MGD for 3 months. Such storage could result in some degradation of water quality, and stored waters would require complete treatment for domestic use. Emergency storage would impact vegetation at the lower levels of the reservoir and could increase warm water fisheries with a decline in the cold water fisheries. Storage above elevation 240 feet NGVD, storage capacity 410 acre-feet (134 MG), would close down, by inundation, a recreation area in the upstream reservoir area, and would not be recommended except under emergency conditions. There could be other related environmental impacts.

A review for compliance with all current applicable environmental, riparian or other laws would be required at the time of any decision to pursue drought contingency storage at the project. The Corps of Engineers would not consider drought storage activities at West Hill without an official request from the State of Massachusetts.



WATER RESOURCES DEVELOPMENT PROJECT

BLACKSTONE RIVER BASIN

BASIN MAP

NEW ENGLAND DIVISION, WALTHAM, MASS.
JANUARY 1980

Plate 1

WEST HILL RESERVOIR

AREA AND CAPACITY TABLE

(Drainage Area = 27.9 sq. mi.)

Reservoir Level (feet)		Area	Capacity	
Stage	Elevation	(acres)	(acre-feet)	(inches)
0	234 (1)	0	0	0
1	235	4	0	0
2	236	40	30	.02
3	237	80	70	.05
4	238	120	160	.11
5	239	150	270	.18
6	240	168	410	.27
7	241	182	580	.40
8	242	196	770	.52
9	243	209	980	.66
10	244	226	1200	.80
11	245	245	1430	.96
12	246	269	1700	1.13
13	247	297	1980	1.33
14	248	328	2290	1.53
15	249	362	2630	1.75
16	250	393	2990	2.00
17	251	422	3360	2.22
18	252	450	3800	2.54
19	253	480	4270	2.86
20	254	509	4790	3.21
21	255 (2)	544	5370	3.60
22	256	592	5970	4.00
23	257	656	6600	4.42
24	258	718	7250	4.86
25	259	772	7990	5.35
26	260	826	8750	5.86
27	261	879	9600	6.43
28	262	930	10540	7.06
29	263	980	11490	7.70
30	264 (3)	1025	12440	8.33
31	265	1078	13600	9.11
32	266	1124	14700	9.85
33	267	1173	15800	10.58
34	268	1222	16900	11.32
35	269 (4)	1270	18000	12.06

(1) Invert Elevation
(2) Fee-Taking Elevation
(3) Spillway Crest Elevation
(4) Easement Elevation

PLATE 2

PERTINENT DATA

WEST HILL DAM AND RESERVOIR

LOCATION — West River, Uxbridge, Massachusetts

DRAINAGE AREA — 27.9 square miles

STORAGE USE — Flood control

RESERVOIR STORAGE

	Stage-Level (ft)	Stage-Level (ft, msl)	Capacity: Area (acres)	Capacity: Acre-Feet	Capacity: Inches on Drainage Area
Invert	0	234.0	0	0	0
Spillway Crest	30	264.0	1,025	12,440	8.3
Maximum Surcharge	42.8	276.8	1,700	29,500	19.8
Top of Dam	48	282.0	-	-	-

DAM EMBANKMENT FEATURES

Type	Rolled earth fill with rock slope protection
Length (feet)	2,400
Top Width (feet)	15
Top Elevation (ft, msl)	282.0
MaximumHeight (feet)	48
Volume (cubic yards)	327,800
Slopes	1 on 2.5

DIKE FEATURES

	Dike "A"	Dike "B"	Dike "C"	Dike "D"
	Rolled earth fill with rock slope protection			Gravel slopes
Length (feet)	420	460	390	640
Top Elevation (feet, msl)	282.0	282.0	282.0	282.0
Maximum Height (feet)	10	14	8	5
Slopes	1 on 2.5	1 on 2.5	1 on 2.5	1 on 4 and 1 on 2
Top Width (feet)	15	15	15	30

SPILLWAY

Location	Right abutment
Type	Concrete gravity, ogee weir
Crest Length (ft)	50
Crest Elevation (ft, msl)	264.0

OUTLET WORKS

Type	3 conduits through spillway
Conduit Inside Dimensions (ft)	3' wide x 5' high
Conduit Length (ft)	39
Gate Type	Vertical lift
Gate Size	3' wide x 5' high
Emergency Gates	None
Downstream Channel Cap. (cfs)	425±
Max. Discharge Capacity (cfs)	1,400 (at spillway crest elevation)
Stilling Basin	None - rock channel

LAND ACQUISITION

Fee Elevation (feet, msl)	255
Easement Elevation (feet, msl)	269

MAXIMUM POOLS OF RECORD

Date	March 1968	January 1979
Stage (feet)	24.3 (258.3 feet msl)	24.2 feet
Percent Full	60	59

SPILLWAY DESIGN FLOOD

Peak Inflow (cfs)	26,000
Peak Outflow (cfs)	8,900 (spillway discharge only)
Volume of Runoff (acre-feet)	38,200

UNIT RUNOFF

One-Inch Runoff (acre-feet)	1,488

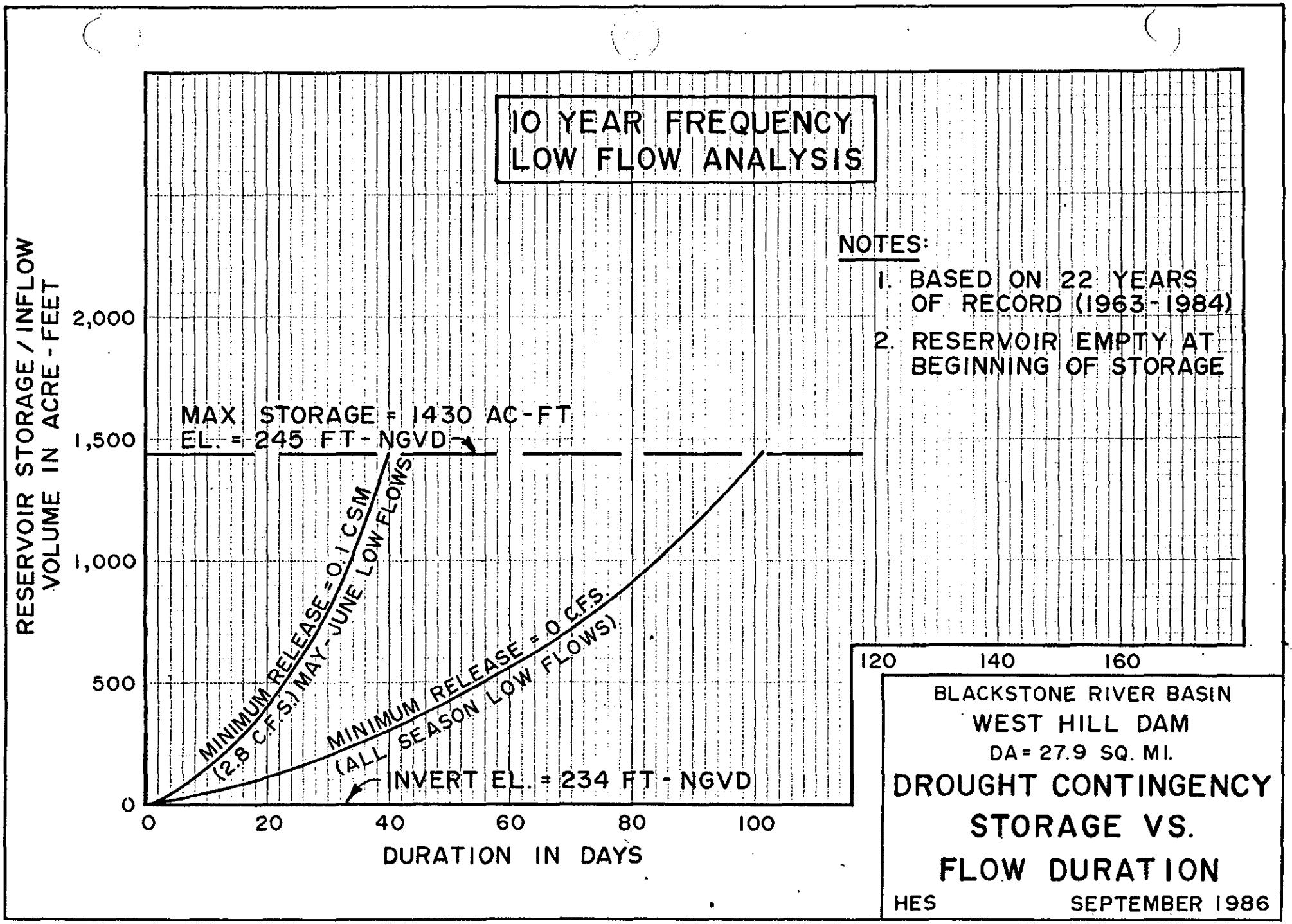
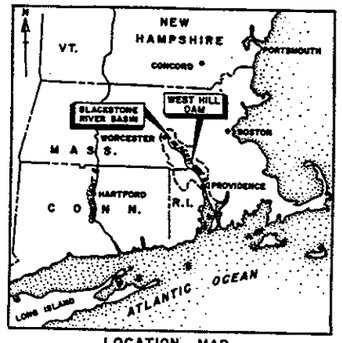

10 YEAR FREQUENCY
LOW FLOW ANALYSIS
NOTES:
1. BASED ON 22 YEARS OF RECORD (1963-1984)
2. RESERVOIR EMPTY AT BEGINNING OF STORAGE
RESERVOIR STORAGE / INFLOW VOLUME IN ACRE-FEET
2,000
1,500
1,000
500
0
MAX. STORAGE = 1430 AC-FT
EL. = 245 FT-NGVD
MINIMUM RELEASE = 0.1 CSM (2.8 C.F.S.) MAY-JUNE LOW FLOWS
MINIMUM RELEASE = 0 CFS. (ALL SEASON LOW FLOWS)
INVERT EL. = 234 FT-NGVD
0
20
40
60
80
100
120
140
160
DURATION IN DAYS
BLACKSTONE RIVER BASIN
WEST HILL DAM
DA = 27.9 SQ. MI.
DROUGHT CONTINGENCY
STORAGE VS.
FLOW DURATION
HES
SEPTEMBER 1986

PLATE 4

CORPS OF ENGINEERS

U.S. ARMY



LOCATION MAP

SCALE IN MILES

30 0 30 40

UPTON

MENDON

NORTHBRIDGE

UXBRIDGE

PRATT POND

TAFT POND

FLOW LINE AT SPILLWAY CREST EL. 2640

WEST HILL ROAD RECREATION AREA

PERMANENT BARRICADE

DAM

OUTLET CHANNEL

INTAKE CHANNEL

FISHING ACCESS

ACCESS ROAD

DIKE "A"

DIKE "B"

DIKE "C"

PUBLIC USE AREA

PERMANENT BARRICADES

SINGLE GRAVE CEM.

RICE CITY POND

BLACKSTONE RIVER

1. 2. 3. 4. 5. 6. 7.

LEGEND

- Existing numbered routes
- Existing paved highways
- Existing gravel roads
- Road barricade
- Civil township or county line
- Public day use areas
- Reservoir at spillway crest El. 264.0

SCALE IN FEET

1000' 0 1000' 2000'

NOTE: MENDON ROAD, HARTFORD AVE, PLEASANT & WEST RIVER STREETS ARE ABOVE SPILLWAY CREST AND REQUIRE NO BARRICADES.

WATER RESOURCES DEVELOPMENT PROJECT

BLACKSTONE RIVER BASIN

WEST HILL RESERVOIR

RESERVOIR MAP

SHOWING ROAD BARRICADES

NEW ENGLAND DIVISION, WALTHAM, MASS.

JUNE 1978

PLATE 5